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QUESTIONS AND ANSWERS

ON THE

EUROPEAN CORN BORER

Revised January 1, 1928



List of Questions

- (1) How and when was the European corn borer brought into this country? P. 4
- (2) What is the life history of the borer? What is meant by the single generation form? Two generation form? P. 4.
- (3) On what plant does the borer live? P. 5.
- (4) How does the borer attack the corn plant? P. 5.
- (5) How can the presence of borers be detected in a cornfield? P. 5.
- (6) What territory is in the infested area? P. 5.
- (7) How destructive has the borer been? How heavy the infestation? P. 5.
- (8) How many borers per stalk constitute commercial damage? P. 6.
- (9) What has been the spread of the borer in New England? P. 6.
- (10) Can the borer be eradicated? P. 6.
- (11) What has been done to control the borer? P. 6.
- (12) What research work is being carried on in connection with the corn borer? P. 7.
- (13) What is being done in Canada to control the borer? P. 7.
- (14) How heavy is the present infestation of the borers in the area in the Lake Region in which they first appeared? P. 7.
- (15) In how many new counties and townships was the borer discovered in 1927? P. 7.



UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF ENTOMOLOGY
WASHINGTON, D. C.

8/10/2000

- (16) How is the annual survey of corn borer infestation conducted? p. 8.
- (17) How far is the borer likely to advance in a year? p. 8.
- (18) How is the spread determined? p. 8.
- (19) If no corn is growing in a given area, will this stop the borer? p. 8.
- (20) What effect does plowing completely under have on the borer? p. 8.
- (21) How does moisture or the lack of it affect the borer in stalks in fields, feed lots, barnyards? p. 8.
- (22) What is being done to find parasites to help control the borer? p. 9.
- (23) Why is not poison used in combating the borer? p. 9.
- (24) Do corn borer moths fly all hours of the day and night? Why are light traps not used to catch moths in their flight? p. 9.
- (25) What agronomic methods of control have been studied? p. 9.
- (26) How effective was the \$10,000,000 clean-up campaign in 1927? p. 9.
- (27) In what States and counties was the clean-up campaign conducted? p. 10.
- (28) How was the \$10,000,000 spent? p. 10.
- (29) What constituted a satisfactory clean-up in the 1927 spring campaign? p. 11.
- (30) What was the farmer paid for his clean-up and how? p. 11.
- (31) What special machinery was bought? p. 11.
- (32) What were the main divisions of the 1927 spring campaign organizations? p. 11.
- (33) What was the organization of the control forces? p. 11.
- (34) Who were the regulatory officials? What were their duties? p. 11.
- (35) How was the extension or educational work of the 1927 spring clean-up campaign organized? p. 11.
- (36) What methods of educating the farmer were used? p. 12.

- (37) How was the information service through the press and other agencies conducted? p. 12.
- (38) What was the relation between the extension and regulatory forces? p. 12.
- (39) What extension work is now being done? p. 12.
- (40) What State legislation is now in force? p. 13.
- (41) By whom were the proposed control measures under the Corn-Borer Act of 1927 prepared? p. 13.
- (42) Who are the executive officers of the International Corn-Borer Committee? p. 13.

QUESTIONS AND ANSWERS

1. How and when was the European corn borer brought into this country?

Ans. It came into this country about 18 years ago in shipments of broom-corn from southern Europe, Italy, and Hungary, some of which landed near Boston. That was before any law on the subject or any power to guard against such a pest had been provided. Little mention of the corn borer was found in European literature. It was not recognized or reported as one of the principal pests of Europe. Consequently, we were not on guard against it. This period, 1909-1910, when the broomcorn came over, was a period when we had a very short crop in this country. There was therefore, an unusually large importation during that period, about 10,000 tons of broomcorn being brought in from abroad. The broomcorn was distributed at many different points, and a separate infestation also occurred in Ontario, Canada. The infestation which is now causing the most serious trouble is the result of the original establishment in Canada from which the spread has occurred throughout the Lake Erie region.

2. What is the life history of the borer? What is meant by the single-generation form? Two generation form?

Ans. In the Great Lakes region the corn borer reproduces but once a year. This is known as the single-generation form. In New England it reproduces twice a year. This known as the two-generation form.

In the case of the single-generation form the moths that emerge in the late spring lay their eggs, and the resulting larvae do the damage. These larvae mature in the fall and hibernate during the winter. They emerge again as moths the next year. The moth which lays the egg lives two or three weeks and can fly some distance. The egg stage exists for an average of ten days (5 to 12 days, depending on the temperature). In the lake region the eggs hatch in June or July and the borer becomes mature in September. It then goes through the winter and becomes a moth again in the following June. It remains in the borer stage for about seven months before it becomes a moth.

In the case of the two-generation form of the New England area the moths emerge in the late spring and lay their eggs, from which a brood of larvae is produced. These larvae develop rapidly and the resulting moths emerge in August. The new moths then lay eggs producing a brood of larvae in August and September, which go into hibernation in the fall and emerge as moths the following spring. In the two-generation area the seasons have been dry and cooler than usual for the last few years, so that the second generation was weakened and a great many larvae died or failed to mature until the following spring.

3. On what plants does the corn borer live?

Ans. In Massachusetts the insect is now known to infest more than 200 different plants. In fact, the borer may infest any kind of succulent plant and even plants that are ordinarily not considered succulent, such as the grapevine. It infests corn from the top ear to the ground, and occasionally goes into the ground 2 or 3 inches. Corn is the favorite host plant and in the lake region it is corn which is principally attacked. Around Boston, where corn is comparatively scarce, the borer feeds on a great diversity of crops and breeds in many sorts of wild plants and weeds.

4. How does the borer attack the corn plant?

Ans. The chief injury by the borer comes from the insects boring into the stalks so that the stalks break and the ears are not able to mature. The main damage is done by boring up and down in the cornstalks. Serious losses also result because of the reduction in the number and quality of ears.

5. How can the presence of borers be detected in a cornfield?

Ans. Two easily distinguished signs of the corn borer in a field are: first, the broken tassel caused by the borer tunneling in the stalk and second, the large quantities of yellowish-white frass, pushed out of the entrance hole of a borer and either suspended there by the silken strands spun by the larva or collected between the leaf sheaths and the stalk.

6. What territory is in the infested area:

Ans. The infested area on November 1, 1927 included all of New York State except 8 counties in the southeast, the northwestern half of Pennsylvania, Ohio as far south as Pickaway County, the northeastern corner of Indiana as far west as St. Joseph county, the southeastern half of Michigan as far north as Cheboygan county in the northern part and as far west as New Buffalo township, Berrien county, in the southern part.

7. How destructive has the borer been? How heavy the infestation?

Ans. The possible damage from the borer in the western area has been indicated in southern Ontario, where the damage in Kent and Essex counties has made it impossible to continue commercial corn growing. In these two counties there was a 5 $\frac{1}{2}$ % infestation, or 3 stalks in 100 contained the borer, in 1922; a 50% infestation, or 50 stalks in 100 contained the borer, in 1923; a total failure in 10 square miles in 1924; a total failure in 400 square miles in 1925; a total failure in 1200 square miles in 1926. In the spring of 1927, a concerted clean-up was undertaken and the infestation was reduced 60%.

In the United States the actual monetary loss up to the present time, compared to the value of the whole corn crop, has not been large. In some individual fields, however, there has been 20 to 50 per cent damage. The heaviest infestations in the United States are along the lake front in Michigan, Ohio, Pennsylvania and New York. In the remainder of the area the insect is just spreading out here and there and has not developed in sufficient numbers to affect the crop.

In 1927 field survey of corn borer infestation showed the heaviest infestation to be in St. Clair County, Michigan where 115 borers per 100 stalks was reported.

6. How many borers per stalk constitute commercial damage?

Ans. Commercial damage depends upon the number of borers per stalk, the variety of corn and the size and vigor of the plants. As a rule, an infestation of 5 borers per stalk produces little commercial loss while an infestation of 30 borers per stalk produces total loss of the crop. A commercial loss will probably be felt with 10 borers per stalk in field corn and with a slightly less number of borers per stalk in sweet corn.

9. What has been the spread of the borer in New England?
(townships)

Ans. In the 49 towns covered by the fall survey in 1926 and 1927, there was an 88 per cent increase in the infested stalks and a 177 per cent increase of larvae per 100 stalks. In spite of this increase 19 of these towns showed a decrease of infested stalks, and 20 a decrease of larvae per 100 stalks. There was no increase or spread noted in a northerly or westerly direction.

10. Can the borer be eradicated?

Ans. Eradication is considered impossible. The object of control measures is to retard the spread of the borer and reduce infestation to a minimum.

11. What has been done to retard the spread of the corn borer?

Ans. The seriousness of the situation was realized in 1917, when a foreign quarantine was declared to prevent further introductions and domestic quarantine established to prevent artificial spread of the borer in this country. In Pennsylvania, Ohio, and Michigan during the summer of 1926, 100 roads were patrolled and approximately 2,000,000 automobiles were stopped. In the summer of 1927, 5,408,812 cars were stopped in the States of Indiana, Ohio, Michigan and Pennsylvania and 5,674 dozen ears of corn were taken.

Because of the quarantine, dangerously infested corn has been taken several times from Iowa-bound cars, frequently from cars on their way to Florida, and a large number of ears were intercepted on their way to Chicago and points in the infested area in Indiana.

Because of the alarming spread of the borer toward the Corn Belt in 1926, Congress appropriated \$10,000,000 in 1927 for the control of the borer through an intensive clean-up campaign. The campaign was carried on in 5 States and 2,500,000 acres of 1926 corn land was cleaned up, on which old stalks and corn remnants were destroyed.

12. What research work is being carried on in connection with the corn borer?

Ans. The best trained specialists in the country, State as well as Federal, which include entomologists, agricultural engineers, agronomists, chemists, ecologists, soil scientists, meteorologists, livestock specialists, and agricultural economists, have been made available for a study of all phases of the corn borer problem, including the life history, habits, and relation of the borer to environment, the breeding of varieties of corn adapted to corn borer conditions, the development of parasites of the borer, and the improvement of machinery for mechanical control.

13. What is being done in Canada to control the borer?

Ans. In Canada, a clean-up campaign somewhat similar to that carried on in the United States was conducted in 1927 in 8 counties in Ontario. The farmers in the Canadian campaign area, however, were not paid for their extra labor and all the work was done with ordinary farm machinery. In the two worst infested counties, Essex and Kent, there was a reduction of 50 per cent in the infestation in 1927, although this was partly due to weather conditions unfavorable to the corn borer.

14. How heavy is the present infestation of the borers in the area in the Lake Region in which they first appeared?

Ans. In western New York in 1926 the estimated loss in certain fields of Dent corn was 25 per cent of the crop, and a similar loss was experienced in sweet corn grown for canning. In 1927 the average borer population per 100 stalks decreased from 12 to 10 borers. In Jerusalem township, Lucas County, Ohio one of the first places in which the borer was discovered in the western area, the 1927 figures showed an average of 131 borers per 100 stalks, the 1926 figures showed an average of 174 borers per 100 stalks. Only in certain badly infested fields is commercial damage evident.

15. In how many new counties and townships was the borer discovered in 1927?

Ans. The annual survey of corn borer infestation in 1927 discovered the corn borer in 461 new townships, of which 237 are in Ohio, 35 in Michigan, 72 in Indiana, 56 in Pennsylvania, and 1 in New York. Some of the townships are in counties in which infestation was reported in 1926. The borer has been found in 55 new counties in 1927; 18 in Ohio, 14 in Pennsylvania, 12 in Michigan, 10 in Indiana, and one in New York.

16. How is the annual survey of borer infestation conducted?

Ans. Five fields are taken in each township within what is known as the one per cent area. This area includes all fields which have on an average one stalk or more in every 100 infested by the corn borer. 100 stalks from the center of each quarter of a field and 100 stalks from the center of the field are carefully examined for any trace of borers. Ten stalks in each field are dissected. From figures thus obtained the borer population of the township is estimated.

17. How far is the borer likely to advance in a year?

Ans. The corn borer's average spread per year is about 20 to 30 miles. The direction and velocity of the winds at night during the 3 or 4 weeks in June and July when the moths are flying appears to influence the rapidity of spread in any one year. The area known to be infested in 1926 was 50% more than in 1925. It increased very much more rapidly in 1926 than previously.

18. How is the spread determined?

Ans. Corn borer scouts are employed by the United States Department of Agriculture to scout the cornfields in the border areas looking for any sign of borers. Points in non-infested areas and river valleys leading out of the infested areas are also scouted. These scouts are specially trained for this work. There were 472 scouts employed in 1927.

19. If no corn is grown in a given area, will this stop the borer?

Ans. No. If corn is not planted, the borers will live by breeding in weeds, large grasses, etc., and will not be exterminated. When the favorite host, corn, is not available, the corn borer is capable of living on many other succulent plants.

20. What effect does plowing under completely have on the borer?

Ans. Plowing does not kill many borers directly. When plowed under, the borers come to the surface, but if no corn remnants or other debris are left on the surface, they perish from exposure, or they are eaten by birds, insect enemies or other predators. Where debris is left on the surface of the field the borers take refuge in this and later produce motas.

21. How does moisture or the lack of it affect the borer in stalks in fields, feed lots, and barnyards?

Ans. When standing corn stalks dry out the borers therein descend to the lower portions where sufficient moisture usually remains to supply their needs. Where the corn is cut and shocked and later becomes very dry, the borers contained in it are quite likely to migrate to standing stubble in the vicinity. In the case of stalks remaining on feed lots the borers usually remain in them throughout the winter. Where the stalks are completely trampled under the surface of liquid manure or mud the borers are destroyed, but if any parts of the stalks remain protruding from the surface the borers take refuge in them and may survive.

22. What is being done to find parasites to help control the borer?

Ans. A total of 12 different species of parasites have been brought from Europe and tried out. Six species have become established on the corn borer in New England, and in the western area. In Europe, parasites are not able to completely control the borer. It is hoped, however, that they will assist materially in taking care of the borers which are not destroyed by clean-up measures. It has been determined that none of these parasites can by any chance become harmful to plants.

23. Why is not poison used in combating the borer?

Ans. The borer spend nearly all its life hidden within the corn stalks where it can not be reached by poisons. The moths deposit their eggs over a period of at least 3 weeks, so that newly hatching borers are present throughout a similar period. Some of the borers can be killed by spraying or dusting with poison at this time. In this case, however, it is necessary to make several applications of poison, which involves so great an expense as to make this method impracticable.

24. Do corn borer moths fly all hours of the day and night? Why are light traps not used to catch moths in their flight?

Ans. They fly mostly in the dusk of the evening or at night. The moths are not attracted to lights in sufficient numbers to render them effective for trap purposes. Many kinds and colors of lights have been tested but none of them has proved effective.

25. What agronomic methods of control have been studied?

Ans. Studies are now being carried on to find the effect of time of planting on the corn borer and the development of resistant and tolerant varieties of corn. Results have not yet been such as to warrant widespread use of these methods of control.

26. How effective was the \$10,000,000 clean-up campaign in 1927?

Ans. The rate of increase was cut down to 1/6 the normal increase. In 1926 there were 9 borers to every 2 of the previous year while in 1927 there were 14 borers for every 9 of the previous year. It is estimated by the Department of Agriculture that the 1927 campaign resulted in the destruction of about 95 to 98 per cent of the borers in the clean-up campaign wintering on corn stalks and debris. Taking 100 borers as a unit, there would be 4 left after a 96% clean-up. Of these 4 there would be normally two males and two females. The two females would lay about 400 eggs each, or 800 in all. However, about 85% of the borers hatched die when very young. Therefore, only 15% of the 800 eggs laid by the two female borers, or 120 borers, survive or establish themselves on the new corn crop. This means an increase of 20% over the original 100 borers.

27. In what States and counties was the clean-up campaign conducted?

Ans. Indiana: DeKalb and Steuben Counties; and selected townships in Allen, LaGrange, Noble, and Whitley Counties.

Michigan: Bay, Branch, Calhoun, Genesee, Hillsdale, Huron, Ingham, Jackson, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, Sanilac, Saginaw, Shiawassee, St. Clair, Tuscola, Washtenaw, and Wayne Counties; and selected townships in Kalamazoo and St. Joseph Counties.

Ohio: Ashland, Ashtabula, Carroll, Columbiana, Crawford, Cuyahoga, Defiance, Erie, Fulton, Geauga, Hancock, Harrison, Henry, Huron, Jefferson, Lake, Lorain, Lucas, Mahoning, Medina, Ottawa, Paulding, Portage, Putnam, Richland, Sandusky, Seneca, Stark, Summit, Trumbull, Wayne, Williams, Wood, and Wyandot Counties; and selected townships in Allen, Hardin, Holmes, Knox, Marion, Morrow, Tuscarawas, and Van Wert Counties.

Pennsylvania: Beaver, Butler, Crawford, Erie, Lawrence, Mercer, Venango, and Warren Counties.

New York: Selected townships in Cattaraugus, Chautauqua and Erie Counties.

28. How was the \$10,000,000 spent?

Ans. In round numbers, \$2,750,000 was spent for equipment and machinery, gas and oil, \$250,000 for extension work in informing and educating farmers regarding control methods, \$1,500,000 for general expenses, including office equipment, per diem wages and salaries, \$4,200,000 for payment of extra labor fees to farmers for the acreage cleaned up by them voluntarily, leaving \$1,300,000 for work in fall of 1927 and spring of 1928.

29. What constituted a satisfactory clean up by a farmer in the infested area in the 1927 spring campaign?

Ans. All corn stalks, or other corn remnants of the 1926 crop in the field, in the barnyard or elsewhere about the farm, unless ensiled, has to be destroyed either by burning, plowing under or finely shredding. Stubble has to be plowed under or destroyed with a stubble beater. Any pieces in condition to harbor living corn borer left on the surface after plowing had to be hand picked.

30. Was the farmer paid for the clean-up work done by him and how?

Ans. If the farmer made a satisfactory clean-up, he was paid for his extra labor up to a maximum of \$2.00 per acre on his 1926 corn acreage. His farm was inspected at the time of the clean-up and again in June by the local corn borer inspector. This inspector approved the work and certified the farmer's voucher if no corn remnants in condition to harbor living corn borers were found about the farm. These vouchers were then paid by check from Washington, D. C. At one time, between 4,000 and 5,000 checks were mailed each day to farmers in the campaign area.

31. What special machinery was bought?

Ans. Eight hundred stubble pulverizers were purchased for the 32 counties included in the campaign. These were used for the destruction of corn stubble. Other machinery and equipment purchased included plows, tractors, trucks for transportation of machinery and equipment and automobiles for transporting the supervisors, inspectors, and clean-up crews. For use in a limited number of the badly infested fields and in fields where plowing was impractical, 64 special power burners were purchased.

32. What were the main divisions of the 1927 spring campaign organizations?

Ans. There were three main divisions - (1) The control unit for field clean-up operations and regulatory and control activities, (2) educational activities and (3) publicity and information.

33. What was the organization of the control forces?

Ans. The control work was under the supervision of the United States Department of Agriculture, Bureau of Entomology, with headquarters at Toledo, Ohio. Because of the fact that regulatory work was authorized by State law, the regulatory officials, even though employees of the Department, were deputized by the States in which they worked and as State officials, enforced the clean-up on all farms which did not pass inspection.

34. Who were the regulatory officials? What were their duties?

Ans. The county supervisor was usually nominated by the county corn borer committee composed of local farmers and business men. His appointment was approved at headquarters of the control unit. To help the supervisor, 7 or 8 inspectors were appointed from among the local farmers. These men visited every farm in the county to explain the regulations to the farmer and to inspect his clean-up work. The supervisor was also in charge of the compulsory clean-up work in his county.

35. How was the extension or educational work of the 1927 spring clean-up campaign organized?

Ans. The extension or educational work of the campaign was carried on through the cooperative extension service of the U. S. Department of Agriculture and the State Agricultural Colleges of New York, Pennsylvania, Ohio, Michigan and Indiana and under the direction of the State directors of extension in these States.

36. What methods of educating the farmer were used?

Ans. In the extension or educational work the State and County extension agents and their temporary corn borer assistants instructed the farmers in corn borer control through meetings, demonstrations and personal visits, supplemented by the use of informational mediums. Demonstrations were held in each township in the campaign area to show how a satisfactory clean-up can be made.

37. How was the publicity and information service conducted?

Ans. An information service handled by the editors of the State Extension divisions in cooperation with the Washington extension and information offices supplied news items for the local press, cuts showing the damage done by the borer and control measures, to newspapers and farm papers in the area, bulletins, leaflets, posters, photographs, lantern slides, stickers, cards and radio talks.

38. What was the relation between the extension and regulatory forces?

Ans. The extension forces cooperated with the inspectors and other regulatory agents in explaining the regulations, stressing in particular the advantages of making a satisfactory clean-up before May 15. After May 15, the regulatory forces took charge of the work on farms which did not comply with regulations, the appropriate costs being charged to the owners by the States. It was the work of the extension forces to convince farmers that it was to their own advantage to clean up satisfactorily before requirements were enforced.

39. What extension work is now being done?

Ans. The educational campaign for the fall of 1927 includes the following special features: Low cutting demonstrations conducted in cooperation with the control unit at Toledo in all the 5 campaign States to acquaint the farmer with this method of control; tours of farmers and others interested to the badly infested fields of Kent and Essex Counties, Ontario, and to a field near Port Clinton, Ohio, to show what destruction the borer can bring to a corn crop; plowing demonstrations and contests conducted under the supervisions of county extension agents. The news service maintained during the recent campaign is being continued through the extension editors. Information on the control work and the borer situation is being furnished to newspapers and magazines in the infested area.

40. What State legislation is now in force?

Ans. Under State laws granting such authority, The State department of agriculture in Michigan, Ohio, and Indiana have issued 1928 regulations requiring a clean-up similar to that required in 1927, viz., the destruction of all corn remnants in a condition to harbor living borers. Under similar laws, Pennsylvania and New York are still operating under the 1927 regulations.

41. By whom were the proposed control measures under the Corn-Borer Act of 1927 prepared?

Ans. These plans were prepared at the instance of what is known as the International Corn-Borer Committee, composed of representatives of the farm organizations, agricultural colleges, and experiment stations, State Departments of Agriculture, and other institutions and organizations in the United States and Canada interested in the control of the corn borer and prevention of its spread to the Corn Belt. The actual plans for the clean-up, as approved by the International Corn-Borer Committee, were drawn up by L. H. Worthley, administrator in corn borer control work, Bureau of Entomology, United States Department of Agriculture, and C. O. Reed, Professor of Agricultural Engineering, Ohio State University, with the assistance of representative entomologists, agricultural engineers and others interested in the corn-borer control work in the various States interested.

42. Who are the executive officers of the International Corn-Borer Committee?

Ans. The following are executive officers of the committee:

G. I. Christie, director, Agricultural Experiment Station, Purdue University, Lafayette, Ind., chairman.

C. V. Truax, director, Department of Agriculture, Columbus, Ohio, secretary.

C. F. Curtiss, dean and director, division of agriculture, Iowa State College, Ames, Iowa.

L. E. Call, director, Agricultural Experiment Station, Kansas State Agricultural College, Manhattan, Kansas.

C. G. Woodbury, director, raw products research, National Cannery Association, Washington, D. C.

Arthur Gibson, Dominion Entomologist, Department of Agriculture, Ottawa, Canada.

Sam Thompson, president, American Farm Bureau Federation, Chicago, Illinois.

L. J. Tabor, master, National Grange, Columbus, Ohio.

A. C. Carton, director, bureau agricultural industry, Department of Agriculture, Lansing, Mich.

C. P. Norgord, assistant commissioner, Department of Farms and Markets, Albany, N. Y.

Dr. Charles J. Jordan, Department of Agriculture, Harrisburg, Pa.

